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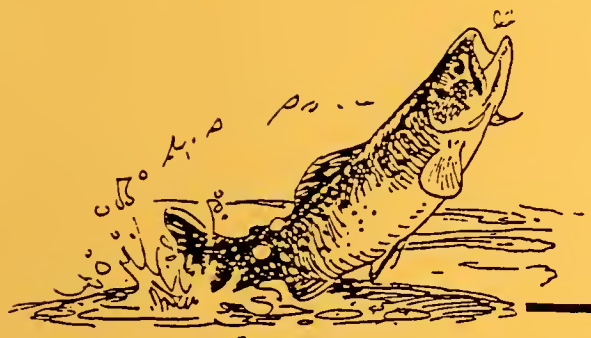
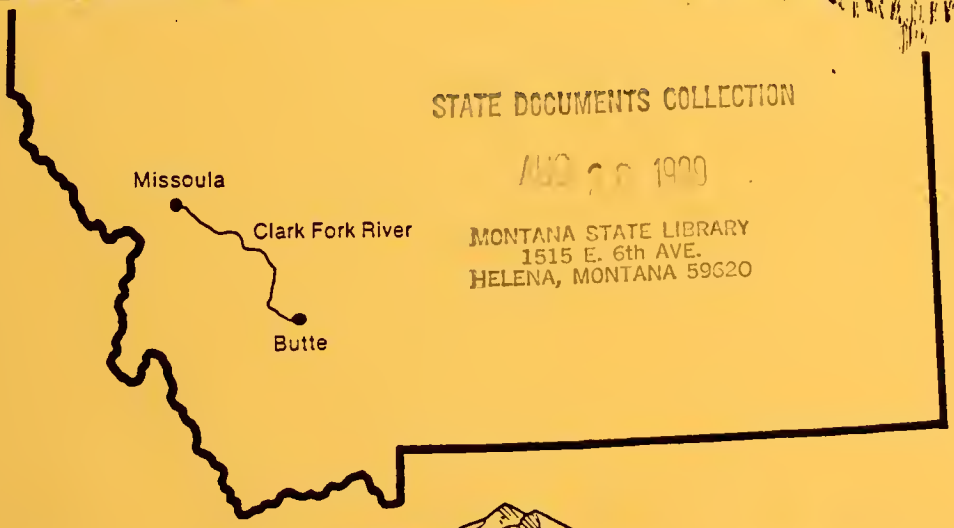
1999
Revised
restoration
determination plan
Smelter Hill area
upland resources

STATE OF MONTANA
NATURAL RESOURCE DAMAGE PROGRAM

REVISED
RESTORATION DETERMINATION PLAN
SMELTER HILL AREA UPLAND RESOURCES
UPPER CLARK FORK RIVER BASIN

JUNE 1999





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REVISED RESTORATION DETERMINATION PLAN
SMELTER HILL AREA UPLAND RESOURCES

PREPARED BY
STATE OF MONTANA
NATURAL RESOURCE DAMAGE PROGRAM

JUNE 10, 1999

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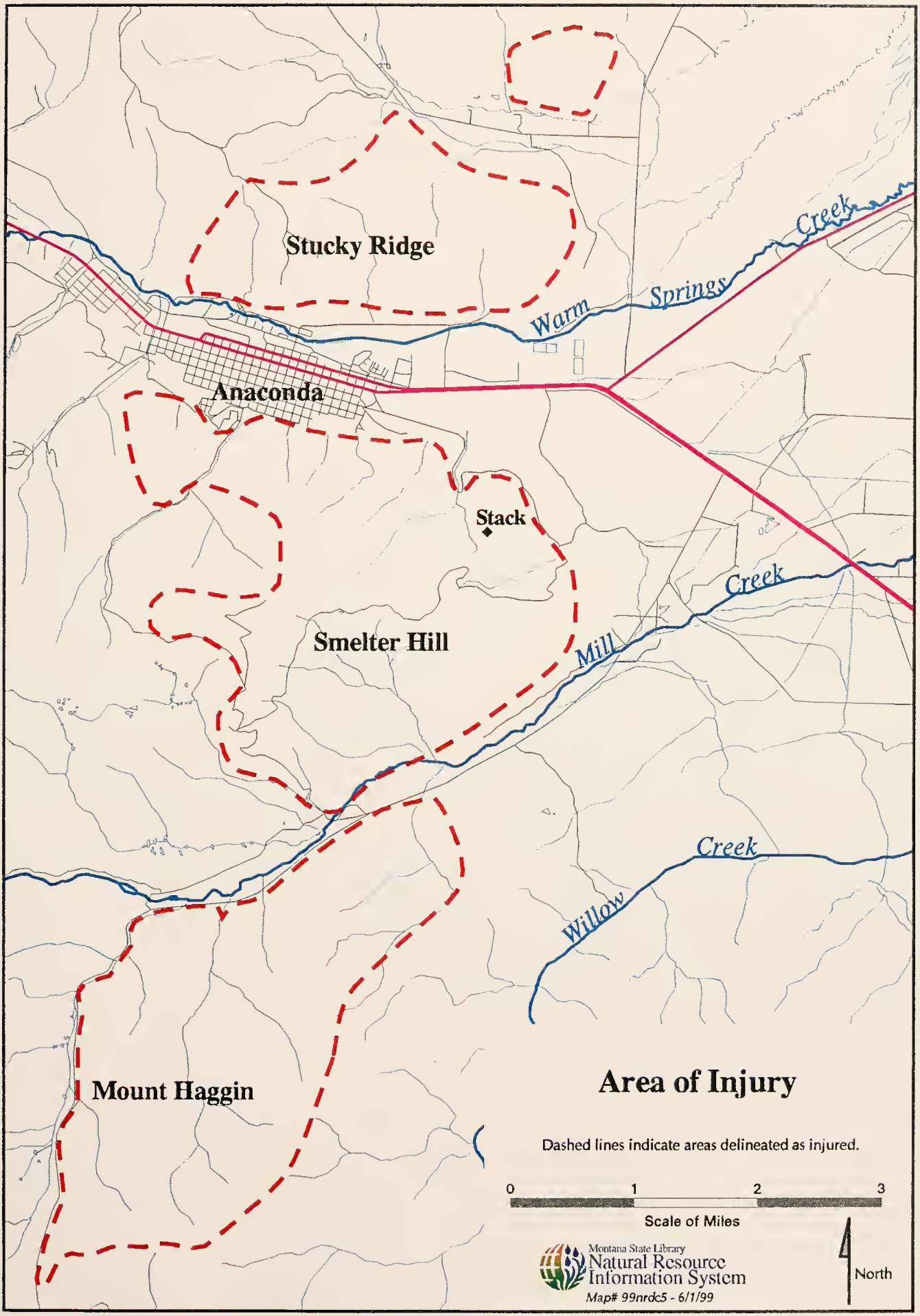
Stucky Ridge
Warm Springs Creek
Anaconda
Stack
Smelter Hill
Mill Creek
Willow Creek
Mount Haggin
Area of Injury
Dashed lines indicate areas delineated as injured.
0 1 2 3
Scale of Miles
Montana State Library
Natural Resource Information System
Map# 99nrdc5 - 6/1/99
North

SMELTER HILL AREA UPLAND RESOURCES

Introduction

In 1995 the State of Montana issued a Restoration Determination Plan (RDP) as part of its natural resource damage assessment. The RDP quantified the appropriate amount of natural resource damages that the State was entitled to in order to restore injured natural resources in the Upper Clark Fork River Basin. Among other resources, the RDP identified the costs to restore an area of uplands around the city of Anaconda. This document revises the 1995 RDP with respect to restoration costs for injured uplands around Anaconda.

A revision is necessary and advisable because the nature and extent of Environmental Protection Agency (EPA) response actions are much more definite than in 1995. At the time the RDP was issued response actions had not been decided upon. Accordingly, the State was required to estimate what EPA would require in the way of response actions and what those actions would mean for the injured resources. The issuance of the Anaconda Regional Water, Waste, and Soils Operable Unit Record of Decision (ROD) in September 1998, which set forth a remedy for a portion of the injured upland area, makes such estimates unnecessary.

The added certainty enables the State to craft a restoration action that meshes with EPA's remedy. An integrated response/restoration action will maximize gains to the resource.

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In addition, selection of a restoration action that complements the EPA remedy results in natural resource damages that are fairer for the Atlantic Richfield Company (ARCO).

The issuance of the ROD also allows the State to renew its claim for natural resource damages for the uplands. In 1998 the State and ARCO agreed to the terms of a consent decree that, on April 19, 1999, was approved by the Court. The consent decree settled a portion of the State's natural resource damage claim. Not settled were restoration cost damages for those areas-one of which was the uplands-not yet the subject of an EPA remedy. The consent decree provides that, upon the issuance of a ROD for an area, the parties will attempt to settle the State's restoration cost damages claim for that area. If settlement is not possible, the consent decree provides that the parties are to return to Court to litigate the issue. The restoration cost damages set forth in this document will form the basis for subsequent negotiations or litigation.

As in the 1995 RDP, this document will characterize the present conditions of the uplands, describe the EPA remedy, and array and examine alternatives for restoring the injured uplands. The State will select an alternative using a list of factors devised by the Department of the Interior and set forth in the natural resource damage assessment regulations. 43 C.F.R. Part 11. The costs of the alternatives will be itemized by their component parts. It is the cost of the selected alternative that

the State seeks in order to satisfy its claim for natural resource damages.

Because this document constitutes a revision to the RDP, procedures mandated by DOI's regulations will be followed. These procedures require that the public be given the opportunity to comment on the selection of alternatives for restoring injured resources. Accordingly, public comment will be accepted and responded to. Public comments received before July 16, 1999 will be considered.

Description of Site and Injury

The uplands around Anaconda have been injured due to releases of hazardous substances from mineral-processing activities. Enormous volumes of hazardous substances, including copper, arsenic, and cadmium, were continually released into the air by these operations and subsequently deposited onto the land.

The primary source of hazardous substances to upland resources was emissions from the Washoe (Anaconda) smelter. Emissions from the Washoe smelter stack resulted in the deposition of hazardous substances across hundreds of square miles of surface soils surrounding and downwind of the stack. This resulted in injury to soils, vegetation, wildlife habitat, and wildlife.

The injury determination undertaken by the State for upland resources delineated those areas displaying gross (visible)

injury attributable to the deposition of hazardous substances released as smelter emissions and/or fugitive dust emissions. Grossly injured resource areas are defined as those areas which exhibit the following:

1) Complete or virtual elimination of major indigenous plant associations;
2) Little or no regeneration of major indigenous plant associations; and
3) Extensive topsoil exposure and erosion due to vegetation loss.

Upland areas which meet the grossly injured criteria extend across approximately 17.8 square miles (11,366 acres) of land. The grossly injured area encompasses the eastern portion of Stucky Ridge and the hills on the north side of Lost Creek Road (2,408 acres), areas to the west and south of Smelter Hill (4,649 acres), and portions of the Mount Haggin Wildlife Management Area east of the Mill Creek Highway (4,299 acres). Elevations in the injured area range from 5,300 feet at the Stucky Ridge injured area to over 7,000 feet at the Mount Haggin injured area.

Soils in the injured area have elevated concentrations of hazardous substances including arsenic, cadmium, copper, lead, and zinc. Laboratory tests have confirmed that these soils are phytotoxic, which is consistent with visual observation of gross injury. Metal concentrations are highest in the upper two inches of soil. Elevated metal concentrations on the soil surface and

upper soil layers prevent vegetation establishment, which explains the lack of natural recovery in the area. Absent human intervention, concentrations will not be reduced sufficiently to allow for revegetation in a reasonable length of time.

In general, across the injured area there has been a shift in plant community types from coniferous forests and grassland to areas of sparse cover consisting of noxious weeds and some grasses or bare ground. In addition, stands of aspens are more prevalent than they would have been had the area not been injured. On the Smelter Hill injured area there are approximately 883 acres of aspen; on the Mount Haggin injured area there are approximately 602 acres of aspen.

Absent hazardous substances in the soil, the injured areas on Smelter Hill and Mount Haggin would have vegetative cover consisting of approximately 70% forest and 30% grassland; the injured area on Stucky Ridge would have vegetative cover consisting of approximately 30% forest and 70% grassland. Of the total 11,366 acres that exhibit gross injury, 6,993 acres (62%) would have been primarily forest land and 4,373 acres (38%) would have been primarily grassland.

The elimination of upland vegetation communities in the grossly injured area has caused a severe disruption to the ecosystem. Most notable has been the drastic reduction in the quantity and quality of wildlife habitat.

Sources of Hazardous Substances

As noted above, the primary source of hazardous substances released to upland resources was emissions from the Washoe smelter stack. Aerial deposition of these hazardous substances has resulted in widespread soil contamination. Mining and mineral-processing wastes disposed of in the Anaconda area are also sources of hazardous substances. Contaminated soils are, in turn, sources of on-going releases of hazardous substances through transport by the wind and redeposition onto the land surface and through surface runoff into water resources.

CERCLA Response Actions

The State has reviewed the Anaconda Regional Water, Waste, and Soils Operable Unit ROD and has participated in discussions regarding its implementation. Although the exact details of the remedial design have yet to be determined, preliminary determinations have been made in EPA's "Draft LRES Phase II Report." In calculating the acreage to be addressed by response actions and in identifying specific actions, the State has relied on the preliminary determinations made in this report.

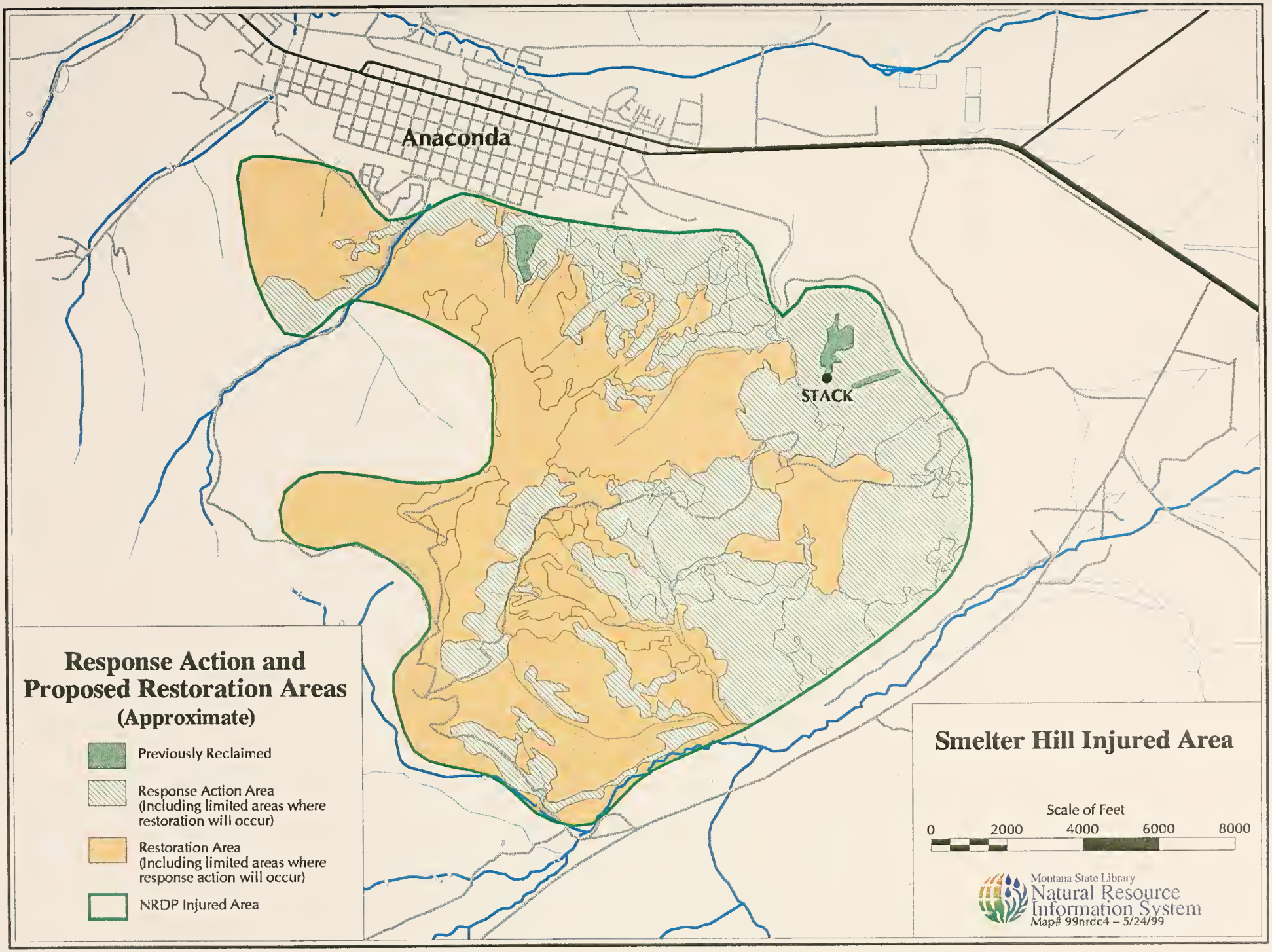
The "key" element of the remedy as set forth in the ROD is "land reclamation." Superfund Remedy Summary (EPA, October 1998). Land reclamation will entail, in large part, revegetation. Two types of revegetation will occur: reestablishment of grasslands and the planting of trees, shrubs, and grasses (PTSG).

Grassland reestablishment will necessitate mechanical tilling, lime and fertilizer amendments, seeding grass, and sporadic planting of trees and shrubs. PTSG will occur on areas less suitable for grassland reestablishment. As the acronym PTSG suggests, its principal focus is on the planting of trees and shrubs. The density of tree and shrub plantings-a critical factor with respect to the efficacy of PTSG-has not been determined. PTSG also entails planting grass in-between the individual tree and shrub plantings.

It is clear that a significant portion of the State's injured area will be reclaimed as a part of EPA's remedy. Moreover, in those areas where reclamation occurs, the effort is likely to be fairly aggressive.

On the Stucky Ridge injured area, reclamation efforts will extend across the entirety of the 2,408 acre area that the State determined was injured. Grasslands will be reestablished over approximately 1,650 acres of the Stucky Ridge injured area and PTSG will occur across 750 acres.

Reclamation efforts on Smelter Hill likely will extend across 2,101 acres of the 4,649 acre injured area. (See attached figure.) Grassland reestablishment will occur on approximately 1,430 acres and PTSG will occur on approximately 671 acres. The remaining 2,548 acres of the Smelter Hill injured area will not be reclaimed, although approximately 200 acres will see limited actions for the purpose of controlling weeds or minimizing soil


Anaconda
STACK
Response Action and Proposed Restoration Areas
(Approximate)
Previously Reclaimed
Response Action Area
(Including limited areas where restoration will occur)
Restoration Area
(Including limited areas where response action will occur)
NRDP Injured Area
Smelter Hill Injured Area
Scale of Feet
0
2000
4000
6000
8000
Montana State Library
Natural Resource Information System
Map# 99nrdc4 – 5/24/99

erosion.

On the Mount Haggin injured area, reclamation, namely PTSG, likely will occur over 205 acres. Thus, 4,094 acres that the State found are injured will not be reclaimed.

Residual Injury

Residual injury means the injury to natural resources that remains after the implementation of response actions. The concept is predicated on the fact that response actions can improve the condition of injured resources and lessen natural resource injury.

It is useful to consider the issue of residual injury not just with reference to the State's three injured areas but by evaluating the specific type of reclamation performed under the EPA remedy. Insofar as grassland reclamation is concerned, due to the level of effort planned, it is highly probable that grasslands will be reestablished. Consequently, natural resource injury in grassland areas will be significantly mitigated.

At those areas where PTSG is to occur, the situation is not as straightforward. To begin with, there is no certainty that grassland reestablishment in-between the plantings of trees and shrubs will be one-hundred percent successful. In those locations in-between plantings where mechanical disturbance and amendments are utilized, grass reestablishment should occur. But, in those locations in-between plantings where these

techniques are not used, grass reestablishment will be less successful and some amount of bare ground or largely bare ground will remain.

More importantly, however, the ability of PTSG to revegetate an area and mitigate natural resource injury will principally be a function of the density of tree and shrub plantings, which, as noted, has not yet been determined. Based on conversations with EPA and Montana Department of Environmental Quality remediation planners, the State believes that density levels of trees and shrubs will be sufficient to significantly advance recovery in areas where PTSG is implemented.

Turning to an evaluation of residual injury specific to the State's injured areas, the scale, intensity level, and type (i.e., predominantly grassland reestablishment) of EPA reclamation efforts at the Stucky Ridge injured area will promote recovery at this area to a significant degree. Residual injury will remain here, however, most notably in the PTSG area where at least some of the areas in-between plantings will remain sparsely vegetated or devegetated, and contingent on the density of tree and shrub plantings.

Similarly, on those areas of the Smelter Hill injured area that are reclaimed, resource conditions will greatly improve. At the Smelter Hill injured area there will be residual injury, both in the PTSG areas and across the 1,665 acres not being addressed by EPA's remedy.

At the Mount Haggin injured area, residual injury will be the most severe of all. This is a function of the simple fact that this area will experience very little reclamation under the remedy.

Most saliently, in the injured areas on Smelter Hill and Mount Haggin that will not be reclaimed as part of the EPA remedy, hazardous substances will remain in surface soils, preventing or retarding the reestablishment of vegetation. Thus, across thousands of upland acres in the Anaconda region, injury will persist for a significant length of time.

RESTORATION

Introduction

Restoration actions must recognize the efforts that will be made by EPA to reclaim a portion of the injured acreage. The State will do this in two ways. First, the State will not attempt to restore those acres that are to be reclaimed. For example, reclamation efforts are to occur across the entirety of the Stucky Ridge injured area. Accordingly, the State will not seek costs to restore any part of this area. Likewise, reclamation is slated to occur on 2,101 acres on the Smelter Hill injured area and 205 acres on the Mount Haggin injured area. No restoration costs will be sought for these.

The State draws this bright line between response actions and restoration actions for a number of reasons. Most notably,

by not seeking restoration costs for the acres that will be subject to response actions, the State believes that it has simplified matters considerably. A simplified presentation, the State believes, will serve to promote either settlement or judicial resolution of the State's restoration cost claim. In addition, at this point in the process of remedial design, the State would be hard-pressed to determine exactly how far short of restoration the reclamation effort will be. Given this difficulty and given that the State expects that the reclamation will produce significant gains to the injured natural resources, the State does not believe that it would be productive for it to seek some incremental amount of natural resource damages to fully restore the areas reclaimed.

In adopting this approach the State has made two critical assumptions. First, the State has assumed that every acre identified as being reclaimed by the Draft LRES Phase II report will, in fact, be reclaimed. In reality, it is possible that every acre will not, in the end, be subject to reclamation. In this eventuality, the approach used here would fail to take these acres into account and would cause the State's claim to be undervalued.

The second assumption the State makes is that PTSG will entail planting trees and shrubs at a density level sufficient to significantly improve the condition of the injured resources. The State's level of confidence with respect to this assumption

allows the State to, in effect, rely on reclamation efforts under the remedy to mitigate natural resource injury in these areas.

It should be noted, and emphasized, that the State reserves its right to seek additional restoration cost damages if either of these assumptions proves incorrect. In other words, if reclamation actually entails fewer acres than is presently stated in the Draft LRES Phase II Report, the State reserves its right to seek restoration costs to restore these acres. Similarly, if the density of tree and shrub plantings is insufficient to significantly mitigate natural resource injury, the State reserves its right to seek restoration costs to fully restore these areas.

The second way that restoration decisions will take into account reclamation efforts is in determining the appropriate amount of grasslands and coniferous forests to be restored. Restoration must be analyzed in terms of the baseline condition of the resources being restored. As noted above, the baseline conditions of the State's injured area constituted two distinct vegetative communities: grasslands and coniferous forests. Consequently, restoration efforts must be directed at restoring these communities so as to reflect the relative amounts of each existing under baseline conditions.

Reclamation by EPA is relevant in this regard because it is also directed at these two community types. Grassland reclamation seeks to reestablish grasslands. PTSG (assuming a

sufficient density of tree and shrub plantings) seeks to create conditions favorable for the reestablishment of a coniferous forest. Accordingly, in devising restoration alternatives that seek to restore the upland injured areas to baseline conditions, the State will take into account the amount of grassland and coniferous forest (PTSG) reclamation expected to occur.

Restoration must also take into consideration areas of aspen that are within the boundaries of the State's injured area. There are approximately 883 and 602 acres, respectively, of aspen stands on Smelter Hill and Mount Haggin. Seeking to restore these areas to a baseline condition would, the State believes, be unwise in that it would require the disturbance of these vegetative communities, which, while not at baseline levels, are in far better condition than their surroundings. Consequently, the State has determined not to seek damages to restore these areas.

Restoration will require revegetating the injured area to provide cover and vegetative diversity necessary to support viable populations of wildlife species typical of southwest Montana upland habitat. Restoration will create improved conditions for wildlife within a reasonable period of time. The goal is to revegetate the injured area to roughly approximate the vegetative communities and their relative abundance that would have existed absent the release of hazardous substances. The time to reach baseline conditions will be significantly

accelerated by a combination of response actions and restoration.

Revegetative success will depend on a number of factors. First, active mixing or turning of the contaminated soils will be required to expose uncontaminated soils and reduce surface soil metal concentrations. For the most part, this will be accomplished by the physical mixing of soil when hand planting trees and shrubs. (In some areas, mechanical means of soil disturbance will be utilized.) Second, revegetation must occur over a large enough area to reestablish a vegetative community capable of moderating the microclimate and providing organic matter and seeds to the surrounding area. Third, soils must be stabilized. Fourth, restoration actions must be carefully planned and targeted to particular site characteristics. Thus, certain criteria such as elevation, slope, and aspect will dictate what happens on the ground.

Alternative 1:

In this alternative revegetation efforts would occur over 3,492 acres of the Mount Haggin injured area and over 1,665 acres of the Smelter Hill injured area. The critical elements of this alternative are (as described in more detail in the cost notes and tables):

1) Mount Haggin: Revegetation of coniferous forest communities and grasslands on the Mount Haggin injured area.

2) Smelter Hill: Revegetation of coniferous forest

communities on the Smelter Hill injured area.

3) O & M: Maintain planting levels on all restored areas by replanting tree seedlings, shrubs, and grasses that have died.

4) Natural recovery.

The Mount Haggin injured area is 4,299 acres. Within this area, 205 acres will be reclaimed under remedy and there are 602 acres of aspen. In accordance with the principles established above, restoration actions will not occur on either of these areas. Consequently, restoration can occur across a total of 3,492 acres of the Mount Haggin injured area.

As noted earlier, 70%, or 3,009 acres, of the Mount Haggin injured area should be coniferous forest. EPA reclamation by PTSG will promote the reestablishment of a coniferous forest across 205 acres. Taking this 205 acres into account, there should be an additional 2,804 acres of coniferous forest on the Mount Haggin injured area.

Under this alternative, coniferous forest restoration will occur across 2,804 acres of the Mount Haggin injured area. Grassland restoration will occur across 688 acres of the Mount Haggin injured area, or the remainder of the injured area subject to restoration actions.

The Smelter Hill injured area is 4,649 acres. Within this area, 2,101 acres will be reclaimed under remedy and there are

883 acres of aspen. Restoration actions will not occur on either of these areas. Consequently, restoration can occur across a total of 1,665 acres of the Smelter Hill injured area.

Seventy percent, or 3,254 acres, of the Smelter Hill injured area should be coniferous forest. EPA reclamation using PTSG will promote the reestablishment a coniferous forest across 671 acres. Taking this 671 acres into account, there should be an additional 2,583 acres of coniferous forest on the Smelter Hill injured area.

As discussed above, restoration actions on the Smelter Hill injured area are limited to 1,665 acres. This alternative seeks to restore a coniferous forest to as many acres as possible, which in this case is 1,665 acres. Accordingly, some 918 acres that should be a coniferous forest within the Smelter Hill injured area will not be restored to that condition.

Coniferous forest restoration will utilize a variety of tree, shrub, and grass species. The restoration action will be implemented based on ecological principles. For example, the proportion of trees and shrubs to be planted in a given area, as well as the specific species to be planted, will depend on site-specific conditions. An area that is south-facing may require fewer trees and more shrubs in comparison to areas with a different aspect. Particular species of trees are better suited for one elevation and moisture regime than another. Planting densities will be 450 trees/shrubs per acre, except in steep

areas where densities will be significantly higher to ensure revegetative success and to control erosion. Tree and shrub density levels will be sufficient to restore a coniferous forest. Grasses, appropriate for the particular area, will be planted along with trees and shrubs as a component of coniferous forest restoration and to enhance, stabilize, and protect soil.

Grassland restoration will entail the planting of grasses, shrubs, and trees. Species of grass that would be present under baseline conditions will be reestablished. Grass seed will be broadcast spread over a specific area at an application rate dependant on the quality and amount of existing vegetation and other site specific factors. Trees and shrubs will be planted at a low density to reflect a baseline grassland community. It should be noted that the level of effort to restore grasslands on the Mount Haggin injured area will be considerably less than the level of effort that will occur under remedy to reclaim Stucky Ridge and Smelter Hill grasslands.

Looking at the injured area as a whole, the implementation of this alternative, in conjunction with the reclamation slated to occur under remedy, will produce significant gains to the uplands. With the growth of trees, shrubs, and grasslands and the reestablishment of habitat complexity and increased availability of cover and forage base, a significant portion of the injured area should again be able to support a variety of wildlife species. Given the present condition of the uplands,

the establishment of a vegetative community representative of baseline conditions over any part of the injured area will constitute an improvement on the scale of many orders of magnitude.

Dramatic improvements in resource conditions would occur as the vegetation takes hold and would continue until it reached relative maturity. After the reestablished vegetation reaches maturity, the rate of improvement in the condition of the uplands would slow as restoration becomes a function of natural processes.

Due to the magnitude of the injury, and the fact that elevated surface concentrations of hazardous substances will remain where the ground surface is not physically disturbed, restoration to baseline over the entirety of the injured area will be a lengthy process. Over time, the revegetated areas will encroach upon the undisturbed areas where vegetation did not reestablish or reestablished only partly. A layer of humus should develop as reestablished vegetation sheds organic matter. Invertebrates, which will have gradually returned to the revegetated core areas, will be recruited to the undisturbed, less vegetated areas when metal concentrations are reduced and sufficient organic matter is available. Mixing of organic litter with soil from the surface and below the surface by invertebrates migrating to the area should dilute metal levels and enhance soil properties. When these events occur, in approximately 200 years,

restoration will be complete.

Alternative 2

In this alternative nothing beyond the reclamation occurring under the EPA remedy is done to the injured area. As alluded to, in those specific areas where reclamation occurs, quite a lot will be accomplished. This is particularly true at the Stucky Ridge injured area where intensive efforts are planned for grassland reestablishment over a substantial portion of the injured area. In the areas targeted for grassland reclamation, restoration will be relatively rapid. In the areas where PTSG is implemented to recreate a coniferous forest, restoration will be slower than in the grasslands because it will take longer for trees and shrubs to reach maturity and because areas in-between plantings that are not physically disturbed will continue to suffer the effects of elevated metals concentrations (again assuming tree and shrub density levels are adequate). At the Smelter Hill injured area, restoration to baseline will take longer simply because the remedy will only address approximately 40% of the injured area. And, at the Mount Haggin injured area, restoration to baseline will be longer still because very little will occur at this area pursuant to the remedy. Under a natural recovery alternative, the Smelter Hill and Mount Haggin injured areas will not be fully restored for many centuries.

EVALUATION OF ALTERNATIVES

Technical Feasibility

The alternatives are equivalent in terms of technical feasibility. Restoration actions under Alternative 1 employs standard revegetation techniques as evidenced by the fact that these same techniques will be employed in response action reclamation efforts.

Cost-effectiveness

A distinction between alternatives cannot be made on cost-effectiveness grounds because the alternatives produce significantly different benefits. Alternative 1 will promote recovery over a significantly larger area than would occur if only natural recovery is relied upon and also will significantly accelerate recovery times.

Results of Response Actions

Alternative 1 has been designed not to overlap with response actions. Accordingly, response actions are being taken into account to their maximum possible extent.

Potential for Additional Injury

Environmental impacts from either Alternative 1 or 2 will be short-term and minor.

Natural Recovery and the Ability of the Resource to Recover

Without intensive actions the injured area will not be restored for many centuries.

Human Health and Safety

There are no significant human health and safety issues associated with these alternatives. Alternatives would be designed and implemented to ensure both workplace safety and public health.

Federal, State, and Tribal Policies

There are no applicable federal, state, or tribal policies implicated by these alternatives.

Federal, State, and Tribal Laws

The alternatives are consistent with applicable law. Before taking any action the State would obtain all necessary permits and authorizations.

Cost-Benefit/Decision making Analysis

The costs of the alternatives, which are displayed on the attached cost sheets, are $15.5 million for Alternative 1 and $0.8 million for Alternative 2. Based on a consideration of the foregoing factors, the State's knowledge of the resource, and for the following reasons, the State selects Alternative 1.

First, the costs associated with this alternative are relatively modest. Second, severe and extensive natural resource injury will remain even after the implementation of response actions. Third, the alternative will produce significant additional benefits to the injured uplands. Fourth, taking restoration actions will complement and augment response actions. Fifth, the alternative is reasonable in that it does not seek to

achieve full restoration immediately but, rather, recognizes what can practically be accomplished. And, sixth, the benefits to be derived from the selection of Alternative 1 far outweigh its costs.

In conclusion, while the State believes that response actions, where occurring, will produce decided improvements in the conditions of those areas, much is left undone. Out of a total of 11,366 acres of upland injury, response actions will address only 4,714 acres. If the remaining acres of injured land are to be addressed and the State of Montana compensated for this injury, the State must recover natural resource damages.

REFERENCES

1) CDM Federal. LRES field forms, Sept/Oct 1998.

2) Holzworth, L., Schaefer, J., Green, G., and Wiersum, T. 1993. The City of Anaconda erosion control and stabilization of "C" Hill. In *Proc. Of the Sixth Billings Symp: Planning, Rehabilitation and Treatment of Disturbed Lands*. Reclam. Resch. Unit Publ. No. 9301, Montana State University, Bozeman, Montana. March 21-27.

3) Keammerer, Warren, R., 1995. Expert Report: State of Montana v. Atlantic Richfield Company. July.

4) Lipton, J.H., Galbraith, H., and LeJeune, K., 1995. Terrestrial Resources Injury Assessment Report: Upper Clark Fork River Basin. Prepared for State of Montana Natural Resource Damage Program. January.

5) U.S. EPA 1998. Record of Decision, Anaconda Regional Water, Waste, and Soils Operable Unit. Anaconda Smelter NPL Site, Anaconda, MT. September.

6) U.S EPA 1999, Preliminary Draft LRES Phase II Report; Preliminary Land Reclamation Alternatives. May.

UPLAND RESOURCES COST TABLES AND NOTES

The following tables display cost estimates for the two alternatives. Explanatory notes follow each table.

Costs were estimated for the alternatives by utilizing the cost estimating methodologies identified in the DOI regulations. Among the methodologies utilized to derive cost estimates are: 1) comparison methodology (43 C.F.R. §11.83(b)(2)(i)), 2) unit methodology (43 C.F.R. §11.83(b)(2)(ii)), and 3) standard time data methodology (43 C.F.R. §11.83(b)(2)(v)).

In particular, estimates were derived from the following general sources (for greater specificity see the cost source references):

1) The Anaconda Regional Water, Waste, and Soils Operable Unit Record of Decision;
2) Actual market prices;
3) Estimated unit costs;
4) Actual unit costs; and
5) Costs for similar construction activities reported in the literature, vendor quotes, or experience and judgment;

The tables contain eight columns. The first, or description, column identifies the particular work item to be costed. The next two columns break the work items into units and identify the quantity of work to be undertaken per year. The fourth column is the unit cost. Next, the cost of the work item in 1999 dollars is displayed.

The sixth column identifies the years that work would occur. Year one is 2000, the year the State wants to begin work. The work schedule reflects the anticipated schedule of response actions so as to coordinate restoration and response actions. The length of time to implement a particular item is based on what is reasonable under the circumstances.

The seventh column identifies the present worth of the work item based on a discount rate of three percent.

The last column presents the total cost of the alternative.

UPLANDS RESTORATION
ALTERNATIVE 1

DESCRIPTION	QUANTITY PER YR	UNIT	UNIT COST	COST/YR 1999 DOLLARS	COST YEARS	PRESENT WORTH @ 3%*	TOTAL COST
A) DIRECT CAPITOL COSTS							
1) MOUNT HAGGIN INJURED AREA							
a) CONIFEROUS FOREST RESTORATION (2,804 ACRES)							
i) NON-STEEP AREAS (1659 ACRES)	277	AC	$1,905 AC	$528,000	1-6	$2,777,000	
ii) STEEP SLOPED >40% AREAS (1145 ACRES)	229	AC	$2,425 AC	$555,000	1-5	$2,468,000	
SUBTOTAL FOR CONIFEROUS FOREST RESTORATION						$5,245,000	
b) GRASSLAND AREA RESTORATION (688 ACRES)	138	AC	$580 AC	$80,000	1-5	$356,000	
SUBTOTAL FOR GRASSLAND RESTORATION						$356,000	
SUBTOTAL FOR MOUNT HAGGIN DIRECT CAPITOL COSTS						$5,601,000	
2) SMELTER HILL INJURED AREA							
a) CONIFEROUS FOREST RESTORATION (1665 ACRES)							
i) NON-STEEP AREAS (1415 ACRES)	202	AC	$1,905 AC	$385,000	2-8	$2,261,000	
ii) STEEP SLOPED >40% AREAS (250 ACRES)	36	AC	$2,425 AC	$87,000	2-8	$511,000	
SUBTOTAL FOR SMELTER HILL DIRECT CAPITOL COSTS						$2,772,000	
SUBTOTAL FOR DIRECT COSTS						$8,373,000	
B) INDIRECT COSTS							
MOBILIZATION/DEMOBILIZATION			5%			$419,000	
ENGINEERING/DESIGN & OVERSIGHT			15%			$1,256,000	
CONTINGENCY FOR CAPITOL COSTS			30%			$2,512,000	
SUBTOTAL FOR INDIRECT COSTS						$4,187,000	
TOTAL CAPITOL COSTS						$12,560,000	
C) O & M COSTS							
1) MOUNT HAGGIN INJURED AREA							
O & M FOR NON-STEEP REFORESTED AREAS	277	AC	$476 AC	$132,000	2-7	$674,000	
O & M FOR STEEP SLOPED REFORESTED AREAS	229	AC	$606 AC	$139,000	2-6	$600,000	
2) SMELTER HILL INJURED AREA							
O & M FOR NON-STEEP REFORESTED AREAS	202	AC	$476 AC	$96,000	3-9	$547,000	
O & M FOR STEEP SLOPED REFORESTED AREAS	36	AC	$606 AC	$22,000	3-9	$125,000	
SUBTOTAL FOR O & M COSTS						$1,946,000	
CONTINGENCY FOR O & M			20%			$389,200	
TOTAL O & M COSTS						$2,335,200	
D) MONITORING COSTS							
1) TRUSTEE OVERSIGHT DURING CONSTRUCTION	1	YR	$25,000 YR	$25,000	1-8	$170,000	
2) SHORT-TERM RESOURCE MONITORING	1	YR	$45,000 YR	$45,000	9-13	$158,000	
3) LONG-TERM RESOURCE MONITORING	1	YR	$22,500 YR	$22,500	14-30	$196,000	
SUBTOTAL						$524,000	
CONTINGENCY FOR MONITORING			20%			$104,800	
TOTAL MONITORING COSTS						$628,800	
TOTAL COST							$15,520,000

* YEAR ZERO IS 1999

ALTERNATIVE ONE

A) **DIRECT CAPITAL COSTS**

1) Mount Haggin Injured Area

Acre Breakdown:

- Injured Area.....4,299
- Response Action.....205
- Aspen Stands.....602
- Restoration Area.....3,492
  - Non-Steep Area.....2,449
    - Coniferous Forest Restoration.....1,659
    - Grassland Restoration.....688
  - Steep Area.....1,145
    - Coniferous Forest Restoration.....1,145

The injured area acreage was determined by the natural resource damage assessment, with assistance from Montana NRIS. The response action acreage derives from the Preliminary Land Reclamation Remedial Alternative sheets in the "Preliminary Draft LRES Phase II Report." The aspen stand acreage was determined by the natural resource damage assessment. The restoration area acreage is the injured area acreage minus the response action acreage and the aspen stand acreage.

The steep and non-steep acreage was determined, first, by identifying steep and non-steep acres across the entire injured area, based on mapping performed by Montana NRIS. These amounts were: 1,248 acres steep and 3,051 non-steep. Second, by identifying the character of the 205 acres of response actions and the 602 acres of aspen stands. Based on an NRDP estimation, 103 acres of the response action are projected to occur on steep lands and 102 acres on non-steep land. Based on Keammerer (1995), 602 acres of aspen stands were on non-steep lands. Accordingly, out of the 3,492 acres slated for restoration, 1145 acres are steep and 2347 are non-steep.

The coniferous forest restoration acreage was determined, first, by identifying the baseline quantity of coniferious forest in the Mount Haggin injured area, based on the State's natural resource damage assessment (70% of 4,299). This amount was 3,009. Second, by taking into account the effects of EPA reclamation. 205 acres of PTSG were assumed to constitute coniferious forest reestablishment. Accordingly, 205 acres was subtracted from 3,009. Thus, 2,804 acres would be subject to coniferious forest restoration. The remainder, or 688 acres, would be restored to grasslands.

The amount of coniferious forest and grasslands restoration that would occur on steep and non-steep areas was based on considerations of baseline conditions. The 1145 acres of steep slopes are not suited to grasslands but to coniferous forest communities. Thus, all of this area would be restored to that condition. The remainder of the coniferous forest restoration, or 1,659 acres, and the grassland restoration, or 688 acres, would occur on non-steep slopes.

a) Coniferous Forest Restoration

Coniferous forest restoration will occur across 2,804 acres (non-steep and steep) of the Mount Haggin injured area. Because of differing site conditions, the details of the restoration action will vary depending on whether a specific area to be restored is non-steep or steep. In all areas trees and shrubs will be planted and grass seed will be broadcast spread in-between plants.

i. Coniferous forest restoration on non-steep areas will occur across 1,659 acres of the Mount Haggin injured area. Plantings will occur over six years (2000-2005). Reforestation will cost $1,905 per acre as outlined below.

CAPITAL COSTS/ACRE

A) TREES AND SHRUBS.....$675
20 and 30 cubic inch container grown seedlings inoculated with mycorrhiza fungi, at an average of $1.50 per stem, with a planting density of 450 stems per acre.

B) PLANTING TREES AND SHRUBS.....$480
150 trees and shrubs planted per 8 hour day @ $20/hour.

C) FERTILIZER.....$75
Trees and shrubs and will be fertilized as will selected areas in-between plantings.

D) SOIL AND PLANT PROTECTION.....$375
A variety of measures must be undertaken to enable revegetation to occur. These include: berming and rock gully plugs for erosion control, addition of organic matter to nutrient depleted soils, netting for tree and shrubs, weed control, and road construction and elimination.

E) FABRIC MULCH.....$100
3 by 3 foot sheets of fabric mulch will be placed around 45% of the planted tree and shrubs to aid in moisture retention.

F) SOIL GOUGING AND GRASS SEED.....$200
Areas in-between plantings of trees and shrubs will receive grass seed. Grass seed will be spread by hand and mechanically. In some areas the soil surface will be disturbed to ready it to receive the grass seed.

TOTAL.....$1,905

ii. Coniferous forest restoration on steep areas will occur across 1,145 acres of the Mount Haggin injured area. Steep sloped areas are defined as areas with a 40 degree or greater slope. Restoration on steep slopes will require hand-planting trees, shrubs, and grasses and soil protection measures over and above that which was required on areas that are less steep. Plantings will occur over five years (2000-2004). Reforestation will cost $2,425 per acre as outlined below.

CAPITAL COSTS/ACRE

A) TREES AND SHRUBS.....$900
20 and 30 cubic inch container grown seedlings inoculated with mycorrhiza fungi, at an average of $1.50 per stem, with a planting density of 600 stems per acre.

B) PLANTING TREES AND SHRUBS.....$640
150 trees and shrubs planted per 8 hour day @ $20/hour.

C) FERTILIZER.....$75
Trees and shrubs and will be fertilized as will selected areas in-between plantings.

D) SOIL AND PLANT PROTECTION.....$375
A variety of measures must be undertaken to enable revegetation to occur. These include: berming and rock gully plugs for erosion control, addition of organic matter to nutrient depleted soils, netting for tree and shrubs, weed control, and road construction and elimination.

E) FABRIC MULCH.....$135
3 by 3 foot sheets of fabric mulch will be placed around 45% of the planted tree and shrubs to aid in moisture retention.

GRASS SEED AND APPLICATION.....$300
Areas in-between plantings of trees and shrubs will receive grass seed. Grass seed will be spread by hand. Grass plugs will also be used in locations where grass seed is unlikely to take.

TOTAL.....$2,425

b) Grassland Restoration

Grassland restoration will occur across 688 acres of the Mount Haggin injured area. All grassland restoration will occur on non-steep areas because, under baseline conditions, grasses would be largely confined to these areas. Grass seed will be spread by hand and by mechanical means and trees and shrubs will be planted at a low density.

A) SOIL GOUGING AND GRASS SEED.....$200
Grass seed will be spread by hand and mechanically. In some areas the soil surface will be disturbed to ready it to receive the grass seed.

B) TREES AND SHRUBS.....$150
20 and 30 cubic inch container grown seedlings inoculated with mycorrhiza fungi, at an average of $1.50 per stem, with a planting density of 100 stems per acre.

C) PLANTING TREES AND SHRUBS.....$105
150 stems per 8 hour day @ $20/hour.

D) SOIL AND PLANT PROTECTION.....$100
A variety of measures must be undertaken to enable revegetation to occur. These include: berming and rock gully plugs for erosion control, addition of organic matter to nutrient depleted soils,

netting for tree and shrubs, weed control, and road construction and elimination.

F) FABRIC MULCH.....$25

3 by 3 foot sheets of fabric mulch will be placed around 45% of the planted tree and shrubs to aid in moisture retention.

TOTAL.....$580

2) Smelter Hill Injured Area

Acre Breakdown:

Injured Area	4,649
Response Action	2,101
Aspen Stands	883
Restoration Area	1,665
Non-Steep Area	1,415
Coniferous Forest Restoration	1,415
Steep Area	250
Coniferous Forest Restoration	250

The injured area acreage was determined by the natural resource damage assessment. The response action acreage derives from the Preliminary Land Reclamation Remedial Alternative sheets in the "Preliminary Draft LRES Phase II Report." The aspen stand acreage was determined by the natural resource damage assessment. The restoration area acreage is the injured area acreage minus the response action acreage and the aspen stand acreage.

The steep (40 degrees or greater) and non-steep acreage was determined by using the percentages of steep and non-steep land for the entire injured area and applying those same percentages to the restoration area acreage. Montana NRIS determined that 15% of the injured area was steep. Accordingly, 250 acres of the restoration area are steep and 1415 acres are non-steep.

The coniferious forest restoration acreage was determined, first, by identifying the baseline quantity of coniferious forest in the Smelter Hill injured area, based on the State's natural resource damage assessment (70% of 4,049). This amount was 3,254. Second, the 671 acres of PTSG were treated as constituting coniferous forest reestablishment and were subtracted from 3,254 acres, resulting in 2,583 acres. (This number, however, exceeds the restoration area acreage.)

a) Coniferous Forest Restoration

Coniferous forest restoration will occur across 1,665 acres (non-steep and steep) of the Smelter Hill injured area. Because of differing site conditions, the details of the restoration action will vary depending on whether a specific area to be restored is non-steep or steep. In all areas trees and shrubs will be planted and grass seed will be broadcast spread in-between plants.

i. Coniferous forest restoration on non-steep areas will occur across 1,415 acres of the Smelter Hill injured area. Plantings will occur over seven

years (2001-2007). Reforestation will cost $1,905 per acre as outlined below.

CAPITAL COSTS/ACRE

A) TREES AND SHRUBS.....$675
20 and 30 cubic inch container grown seedlings inoculated with mycorrhiza fungi, at an average of $1.50 per stem, with a planting density of 450 stems per acre.

B) PLANTING TREES AND SHRUBS.....$480
150 trees and shrubs planted per 8 hour day @ $20/hour.

C) FERTILIZER.....$75
Trees and shrubs and will be fertilized as will selected areas in-between plantings.

D) SOIL AND PLANT PROTECTION.....$375
A variety of measures must be undertaken to enable revegetation to occur. These include: berming and rock gully plugs for erosion control, addition of organic matter to nutrient depleted soils, netting for tree and shrubs, weed control, and road construction and elimination.

E) FABRIC MULCH.....$100
3 by 3 foot sheets of fabric mulch will be placed around 45% of the planted tree and shrubs to aid in moisture retention.

F) SOIL GOUGING AND GRASS SEED.....$200
Areas in-between plantings of trees and shrubs will receive grass seed. Grass seed will be spread by hand and mechanically. In some areas the soil surface will be disturbed to ready it to receive the grass seed.

TOTAL.....$1,905

ii. Coniferous forest restoration on steep areas will occur across 250 acres of the Smelter Hill injured area. Steep sloped areas are defined as areas with a 40 degree or greater slope. Restoration on steep slopes will require hand-planting trees, shrubs, and grasses and soil protection measures over and above that which was required on areas that are less steep. Plantings will occur over seven years (2001-2007). Reforestation will cost $2,425 per acre as outlined below.

CAPITAL COSTS/ACRE

A) TREES AND SHRUBS.....$900
20 and 30 cubic inch container grown seedlings inoculated with mycorrhiza fungi, at an average of $1.50 per stem, with a planting density of 600 stems per acre.

B) PLANTING TREES AND SHRUBS.....$640
150 trees and shrubs planted per 8 hour day @ $20/hour.

C) FERTILIZER.....$75
Trees and shrubs and will be fertilized as will selected areas in-between plantings.

D) SOIL AND PLANT PROTECTION.....$375
A variety of measures must be undertaken to enable revegetation to occur. These include: berming and rock gully plugs for erosion control, addition of organic matter to nutrient depleted soils, netting for tree and shrubs, weed control, and road construction and

elimination.

E) FABRIC MULCH.....$135

3 by 3 foot sheets of fabric mulch will be placed around 45% of the planted tree and shrubs to aid in moisture retention.

GRASS SEED AND APPLICATION.....$300

Areas in-between plantings of trees and shrubs will receive grass seed. Grass seed will be spread by hand. Grass plugs will also be used in locations where grass seed is unlikely to take.

TOTAL.....$2,425

B) **INDIRECT COSTS**

The indirect costs consist of mobilization/demobilization, engineering and design, and contingency. The rates of the indirect costs are based on a percentage of the discounted direct cost. The percentages for all indirect costs are consistent with the Anaconda Regional Water, Waste, and Soils Operable Unit ROD and are typical of such projects.

Mobilization and demobilization was set at five percent.

Engineering and design costs were set at 15 percent. These costs include engineering, design, oversight, and administration of the construction.

Contingency was set at 30 percent. The contingency cost represents normal uncertainty in the costing of the alternatives.

C) **OPERATION AND MAINTENANCE COSTS**

Operation and maintenance costs begin the year after the initiation of work and continues a year after the completion of work. O&M costs are 4 percent of the initial planting costs. No O&M will occur on the grasslands.

D) **MONITORING COSTS**

Monitoring consists of: trustee oversight during construction, short-term resource monitoring, and long-term resource monitoring.

These three categories of monitoring are necessary to assure that the restoration work is performed properly and to evaluate and track the recovery of the resource. Oversight during construction would consist of the review of design documents, preparation of written comments, and periodic site visits. Resource monitoring would consist of periodic monitoring of the injured upland natural resources. Resource monitoring is divided into short-term and long-term. Short-term monitoring is assigned a higher level of effort and cost than long-term monitoring because of the need to determine existing conditions against which later improvements in the conditions of the resources would be measured.

UPLANDS RESTORATION
ALTERNATIVE 2

DESCRIPTION	QUANTITY PER YR	UNIT	UNIT COST	COST/YR 1999 DOLLARS	COST YEARS	PRESENT WORTH @ 3%*	TOTAL COST OF ALTERNATIVE
MONITORING COSTS							
SHORT-TERM RESOURCE MONITORING	1	YR	$45,000 YR	$45,000	1-5	$200,000	
LONG-TERM RESOURCE MONITORING	1	YR	$22,500 YR	$22,500	6-50	$462,000	
SUBTOTAL						$662,000	
CONTINGENCY FOR MONITORING			20%			$132,400	
TOTAL COST							$794,400

* YEAR ZERO IS 1999

MONITORING COSTS

Monitoring consists of: short-term resource monitoring and long-term resource monitoring.

Resource monitoring would consist of periodic monitoring of the injured upland natural resources. Resource monitoring is divided into short-term and long-term. Short-term monitoring is assigned a higher level of effort and cost than long-term monitoring because of the need to determine existing conditions against which later improvements in the conditions of the resources would be measured.

COST SOURCES

1) Andreozzi,Bob,and Bitterroot Restoration personnel. Personal communications.

2) Bitterroot Restoration, Inc. Plant Availability Listing and Prices for spring 1999. Corvallis, MT.

3) Dern, George. 1994. Cost Supporting Document for Uplands Restoration Chapter. December.

4) Montana Conservation Seedling Order Form (Spring 1999) Montana Conservation Seedling Nursery, Missoula.

5) ReForestation Technologies International Price List. 10/98. Salinas, CA.

6) Shaw Fabric Products, 12/98. Fabric mulch costs. Wellington, CO.

7) Tarra Tech, Inc. Tree Netting prices. 12/98. Eugene, Oregon.